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A FIELD EFFICACY STUDY OF STRYCHNINE AND ZINC PHOSPHIDE GRAIN BAITS USING NONTOXIC PREBAIT FOR THE CONTROL OF THE COLUMBIAN GROUND SQUIRREL (*Spermophilus columbianus*)

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by

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ABSTRACT

A field study was conducted in Powell County, Montana, during July 1981, to determine the effectiveness of strychnine and zinc phosphide oat baits used with nontoxic prebait for the control of Columbian ground squirrels. Zinc phosphide was found to be more effective than strychnine in reducing the numbers of active burrows (92.7% vs 73.6%). No nontarget mortalities were observed.

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INTRODUCTION

In 1978 and 1980 the Environmental Protection Agency granted specfic exemptions for the use of compound 1080 to control Columbian ground squirrel damage in Western Montana. Under the terms of the 1978 exemption EPA requested that studies be conducted to compare the efficacy of compound 1080 with that of alternative rodenticides zinc phosphide, strychnine, and gas cartridges. Resulting studies (Albert and Record, 1979) showed compound 1080 to be more effective in reducing Columbian ground squirrel numbers than the other methods treated. Gas cartridges were next in effectiveness but were expensive in terms of manpower and time required for applications.

In the 1980 specific exemption for 1080, EPA requested that field efficacy studies be continued. EPA was particularly interested in comparative efficacies of strychnine and zinc phosphide applied after prebaiting with nontoxic baits.

Generally, efficacy can be increased by conditioning squirrels to consume nontoxic grain applied prior to treatment with poison baits. Current labels for zinc phosphide recommend prebaiting with nontoxic oats to condition ground squirrels to and improve their acceptance of the toxic bait. Matschke (1979) mentioned that ground squirrel mortality from zinc phosphide can be increased 26% by first exposing ground squirrels to untreated oats. The acceptance of strychnine baits can also be increased by prebaiting (Record, 1977; Sullins, 1977). Despite the potential for increasing the effectiveness of the rodenticides prebaiting has been unpopular in Montana because of the increased cost and manpower associated with application of prebait.

OBJECTIVES

The objectives of this study were to determine the efficacy of zinc phosphide and strychnine grain baits applied after a nontoxic prebait for controlling Columbian ground squirrels, to record any nontarget wildlife deaths occurring on treated plots and to record the manhours required for prebaiting and baiting the study plots.

STUDY AREA

The study area was located in the Blackfoot River Valley three miles southwest of Ovando, Montana on a privately owned, nonirrigated pasture heavily populated by Columbian ground squirrels. The vegetation on the site consisted of dryland native grasses and herbaceous plants. Dense patches of snowberry (Symphoricarpus sp.) and areas of sparce sagebrush (Artemisia tridentata) were present on the site. Topography of the area consisted of a broad, level flood plain on the Blackfoot River bordered by steep hillsides rising 75-100 feet to an extensive bench land. The study plots were located on the level sites although some of the hillsides were included in the buffer zones. The weather was characterized by frequent and heavy rains during April, May and June, nearly twice the normal amount of precipitation. July and August were generally hot and dry with occassional thunderstorms. The area was used as pasture during winter and early spring for 30 mules and horses.

METHODS AND MATERIALS

Three study plots were selected within the study area, one for each toxicant tested and one as a control plot. Plots were selected based on near maximum Columbian ground squirrel density for the area and similar topography and vegetation composition for each plot. To help prevent reinvasion of ground squirrels from land bordering the plots a 100 meter (328 feet) buffer zone was treated around each study plot.

Effectiveness of the toxicants was measured by comparing the numbers of active burrows (AB) pre and post treatment. On each plot one hundred burrows were flagged and closed with a shovel of soil and those reopened (active burrows) were counted two days later, just prior to treatment. Two days were believed sufficent opportunity for squirrels to open burrows considering that Matschke (1979) found 87-89% burrows reopened after two days. Four days after treatment this procedure was repeated using the same burrows (Table 1). The burrow closure technique was replicated twice on each plot so that a total of 200 burrows were closed per plot. The two replicates of each plot were located adjacent to each other and together covered 0.7 to 0.8 hectares (1.7 to 2 acres).

The percent reduction in number of active burrows was calculated using the following formula which takes into account the burrows closed and reopened on the treated and controlled plots (Matschke, 1979; Henderson and Tilton, 1955):

$$\text{Percent Reduction} = 1 - \frac{\text{Percent holes reopened post treatment (treated plots)} \times \text{Percent holes reopened pretreatment (control plots)}}{\text{Percent holes reopened pretreatment (treated plots)} \times \text{Percent holes reopened post treatment (control plots)}} \times 100$$

The toxic baits used were 0.5% strychnine alkaloid on rolled oats (EPA Reg. NO. 6704-58, U.S. Fish and Wildlife Service) and 2.0% zinc phosphide on rolled oats (EPA Reg. NO. 6704-74, U.S. Fish and Wildlife Service). Bait was applied by hand using dippers calibrated to contain one teaspoon of bait. Following label directions the application rate was one teaspoon of bait scattered near each burrow entrance. Prebait, consisting of untreated rolled oats, was applied in the same manner 48 hours prior to applying toxic bait. The control plot and its buffer zone were prebaited and baited using untreated rolled oats.

Searches were conducted on day four and day six post treatment for target and nontarget mortality.

RESULTS

Pre and post treatment numbers of active burrows were compared. Columbian ground squirrel activity declined after the application of strychnine resulting in an average active burrow reduction of 73.6% (Range: 70.6 - 76.5%). The 2% zinc phosphide treatment showed an average reduction of 92.7% (Range: 90.6 - 94.8%). The control plot had no reduction in average number of active burrows (Table 2).

One squirrel was found dead on the strychnine test plot. The cause of death was assumed to be strychnine poisoning. No other dead squirrels were found and no nontarget mortality was observed.

DISCUSSION

Bait application probably occurred at near optimum time (late July) for bait acceptance by the squirrels. Tender, succulent vegetation was no longer present. Native grass and herbaceous seed crops were at or near maturity. Signs of squirrels feeding on native seeds were common and acceptance of the untreated prebait was excellent.

The percent control with strychnine bait in this study was in the range of control found in other studies with strychnine grain (65% - Albert and Record, 1979; 64 - 81% - Record, 1976). Historically, strychnine has shown poor control

TABLE 1. SCHEDULE FOR TESTING EFFICACY OF STRYCHNINE AND ZINC PHOSPHIDE GRAIN BAITS ON COLUMBIAN GROUND SQUIRRELS.

DATE	STRYCHNINE PLOT	ZINC PHOSPHIDE PLOT	CONTROL PLOT
July 20, 1981	Burrow Closure	Burrow Closure	Burrow Closure
July 21, 1981	Prebait	Prebait	Prebait
July 22, 1981	Burrow Count	Burrow Count	Burrow Count
July 23, 1981	Bait	Bait	Bait
July 27, 1981	Burrow Closure Nontarget Searches	Burrow Closure Nontarget Searches	Burrow Closure Nontarget Searches
July 29, 1981	Burrow Count Nontarget Searches	Burrow Count Nontarget Searches	Burrow Count Nontarget Searches

TABLE 2. PRE AND POST TREATMENT ACTIVE BURROW COUNTS AND PERCENT REDUCTION IN ACTIVE BURROWS ON PLOTS TREATED WITH STRYCHNINE AND ZINC PHOSPHIDE GRAIN BAITS TO CONTROL COLUMBIAN GROUND SQUIRRELS.

		0.5% STRYCHNINE	2% ZINC PHOSPHIDE	UNTREATED ROLLED OATS (CONTROL)	
Burrows reopened pretreatment per 100 burrows closed	Subplot A	34	39	15	(Average 21)
	Subplot B	34	32	27	
Burrows reopened post treatment per 100 burrows closed	Subplot A	10	2	18	(Average 21)
	Subplot B	8	3	24	
Percent reduction in active burrows	Subplot A	70.6%	94.8%	20.0%*	
	Subplot B	76.5%	90.6%	11.1%	
Average percent reduction in active burrows		73.6%	92.7%	0.0%	

*Increase in active burrows.

of Columbian ground squirrels (Record, 1978A). The bitter taste of strychnine may be a cause of the Columbian ground squirrel's poor control. Percent control with strychnine bait may also be related to the tendency of Columbian ground squirrels not to pouch their food. Record (1978B) found only 7% of the Columbian ground squirrels he examined had food in their cheek pouches. Studies with the California ground squirrel showed only one-fifth the amount of strychnine needed to kill through stomach absorbtion will kill a squirrel if absorbed through the cheek pouches (Merriam, 1910).

The zinc phosphide application resulted in more acceptable control. Prebaiting and application of the bait when seeds of native vegetation were mature likely increased bait acceptance. At this time seeds and grains are an important part of the diet of Columbian ground squirrels. Other studies with zinc phosphide have shown prebaiting with nontoxic grain tends to increase control (Baril, 1980; Swick, 1980; Matschke, 1979; Sullins, 1977). Although prebaiting did increase toxic bait acceptance it doubled labor cost and added cost for the prebait (Table 3). This increase in time and cost have resulted in resistance to prebaiting from most landowners practicing ground squirrel control.

Acceptance of strychnine and zinc phosphide baits and percent control of Columbian ground squirrels varies over a wide range (Baril, 1980; Swick, 1980; Matschke, 1980, 1979; Albert and Record, 1979; Sullins, 1977). Reasons for these inconsistencies are not always clear. Numerous factors, individually and collectively, probably contribute to this variability: 1) unpleasant odor or taste of the toxicant, 2) improper timing of the bait application to coincide with natural seed foraging, 3) application after a portion of the population has begun estivation, 4) different application techniques (hand, broadcast) and quality of applications, 5) types of carrier (grain, vegetables, fruit, feed pellets) and carrier processing (whole, rolled, crimped or groat grain), 6) availability of other, perhaps more preferred food sources, 7) application or nonapplication of prebait, 8) climatic conditions post bait application.

CONCLUSIONS

Even when applied with a prebait and with optimum timing strychnine grain bait did not provide acceptable control of Columbian ground squirrels in this study. Zinc phosphide bait did provide acceptable control applied with a prebait under optimum conditions.

SUMMARY

Efficacy studies were conducted with strychnine and zinc phosphide grain baits after prebaiting with nontoxic grain bait to control Columbian ground squirrels. Reduction in active burrows averaged 73.6% and 92.7% for strychnine and zinc phosphide baits, respectively. No nontarget animals were found dead and only one ground squirrel was found dead during post treatment searches.

TABLE 3. MANHOURS[1] SPENT IN STUDY ACTIVITIES AND POUNDS OF BAIT USED.

PLOT	TREATMENT	
	Prebait[2]	Bait[2]
Strychnine	6.4 hrs.	6.7 hrs.
Zinc Phosphide	9.6 hrs.	9.8 hrs.
Control	6.8 hrs.	6.5 hrs.

	Burrow Closure[3]	
	Pretreatment	Post Treatment
Strychnine	3.2 hrs.	0.7 hrs.
Zinc Phosphide	3.0 hrs.	0.5 hrs.
Control	4.0 hrs.	0.6 hrs.

	Burrow Count[3]	
	Pretreatment	Post Treatment
Strychnine	1.0 hrs.	0.8 hrs.
Zinc Phosphide	1.2 hrs.	0.8 hrs.
Control	1.0 hrs.	0.8 hrs.

	Pounds of Bait Used	
	Prebait	Bait
Strychnine	22 lbs.	23 lbs.
Zinc Phosphide	23 lbs.	27 lbs.
Control	20 lbs.	25 lbs.

1) Manhours recorded do not include time spent setting up plots, travel, nontarget searches and incidental time.

2) Plot size including buffer, 9 hectares/plot.

3) 200 burrows/plot.

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